Electron Collisions with Coherently Excited Atoms. Alignment Creation and Transfer Cross Sections and their Role in Plasma Polarization Spectroscopy

Sandor Trajmar

Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA, 91109

In "conventional" electron-atom collision experiments, one measures differential (integral) cross sections associated with initially ground state species representing averages over initial and final magnetic sublevels. In "conventional" plasma diagnostic spectroscopy, one measures the intensity of emission lines to deduce information about the plasma conditions.

A deeper understanding of electron-atom collision physics requires cross sections for magnetic to magnetic sublevel transitions as well as consideration of the coherence effects in this excitation. To achieve this, one finds to design new, more sophisticated experimental techniques and evaluation schemes. The results of such experiments are magnetic sublevel cross sections, information on alignment (and orientation) creation (destruction) in the electron collision process as well as on coherences among magnetic sublevel transition amplitudes. Experiments will be described concerning, elastic, superelastic, and inelastic electron scattering by coherently prepared ^{138}Ba (...6s6p $^1P_1$) atoms to demonstrate these techniques and the extraction of alignment creation and destruction cross sections from the measurements. Similarly, a deeper understanding of plasma characteristics, requires the measurement not only the intensity of emission lines but also their polarization. We will show how this polarization of radiation is connected to the polarization of the atomic ensemble responsible for this radiation and to the local properties of the plasma.